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Appendix K

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Cost Estimate

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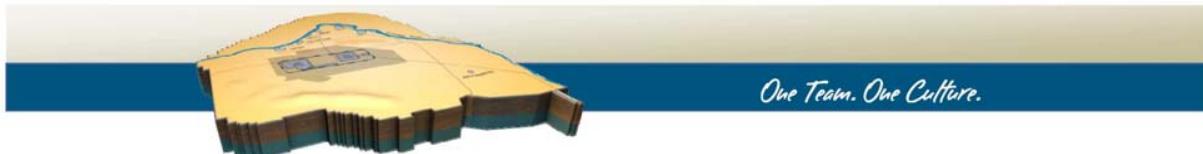
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ENVIRONMENTAL COST ESTIMATE

ECE-100BC111-00007

Environmental Cost Estimate for 100 BC Vadose Zone and Groundwater RI/FS

Revision 1

Date: August 22, 2012

Project: CH2M HILL Plateau Remediation Company

Topic: Cost Analysis

Lead Estimator: S. Ferries

Senior Review: K. Klink

Administrative Use

Terms

AACE	Association for the Advancement of Cost Engineering International
CHPRC	CH2M HILL Plateau Remediation Company
DOE	U.S. Department of Energy
ECE	Environmental Cost Estimate
ECF	Environmental Calculation File
EPA	U.S. Environmental Protection Agency
ERDF	Environmental Restoration Disposal Facility
FICA	<i>Federal Insurance Contributions Act</i>
FP	Fixed-price
G&A	General and administrative
HSSA	Hanford Site Stabilization Agreement
MS Excel™	Microsoft Excel
O&M	Operation and Maintenance
OMB	Office of Management and Budget
PRC	Plateau Remediation Company
PW	Present Worth
RACER™	Remedial Action Cost Engineering and Requirements System (Cost Estimating Software)
RCTs	Radiological Control Technicians
TRACE	Tool for Response Action Cost Estimating, version 3.0, 2012.

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Introduction

CHPRC prepared this Environmental Cost Estimate (ECE) in support of the Remedial Investigation/Feasibility Study Report for the 100-BC Source Operable units (OU) and the 100-BC-5 Groundwater OU (DOE/RL-2010-96). The following sections provide the basis of estimate.

The cost estimates for each waste site summarized in this ECE have been prepared for comparative response action evaluation(s) from the information available at the time of preparation. The cost estimates reflect specific response action approaches, and scope assumptions and exclusions as well as cost estimating methodologies. The response action cost estimates have expected ranges of accuracy described in the “Estimate Classification” section. The final costs of the selected response action will depend on actual labor and material costs, actual site conditions, productivity, competitive market conditions, final project scope, final project schedule, and other factors.

1 Purpose of Estimate

This ECE and cost estimate backup supports the response action alternatives analysis provided in *Remedial Investigation/Feasibility Study Report for the 100-BC Source Operable Units (OU) and the 100-BC-5 Groundwater OU (DOE/RL-2010-96)*. It provides an overview of response action-specific cost inputs, methodology, and results. It also provides documentation of references that provide more detailed scope and cost estimate information used to prepare these estimates.

The purpose of this ECE is to:

- Describe the methodology applied in performing the cost estimates.
- Describe the general and response action-specific assumptions and cost inputs applied to the subject cost estimates.
- Summarize the response action alternative cost estimates.

This ECE also documents the references that provide additional scope and cost estimate information used to prepare these estimates.

2 General Project Description

The 100-BC area consists of the 100-BC-1 and 100-BC-2 Source Operable Units (OUs) and the 100-BC-5 Groundwater Operable Unit within the 100 Area National Priorities List Site located in Washington State at DOE’s Hanford Site.

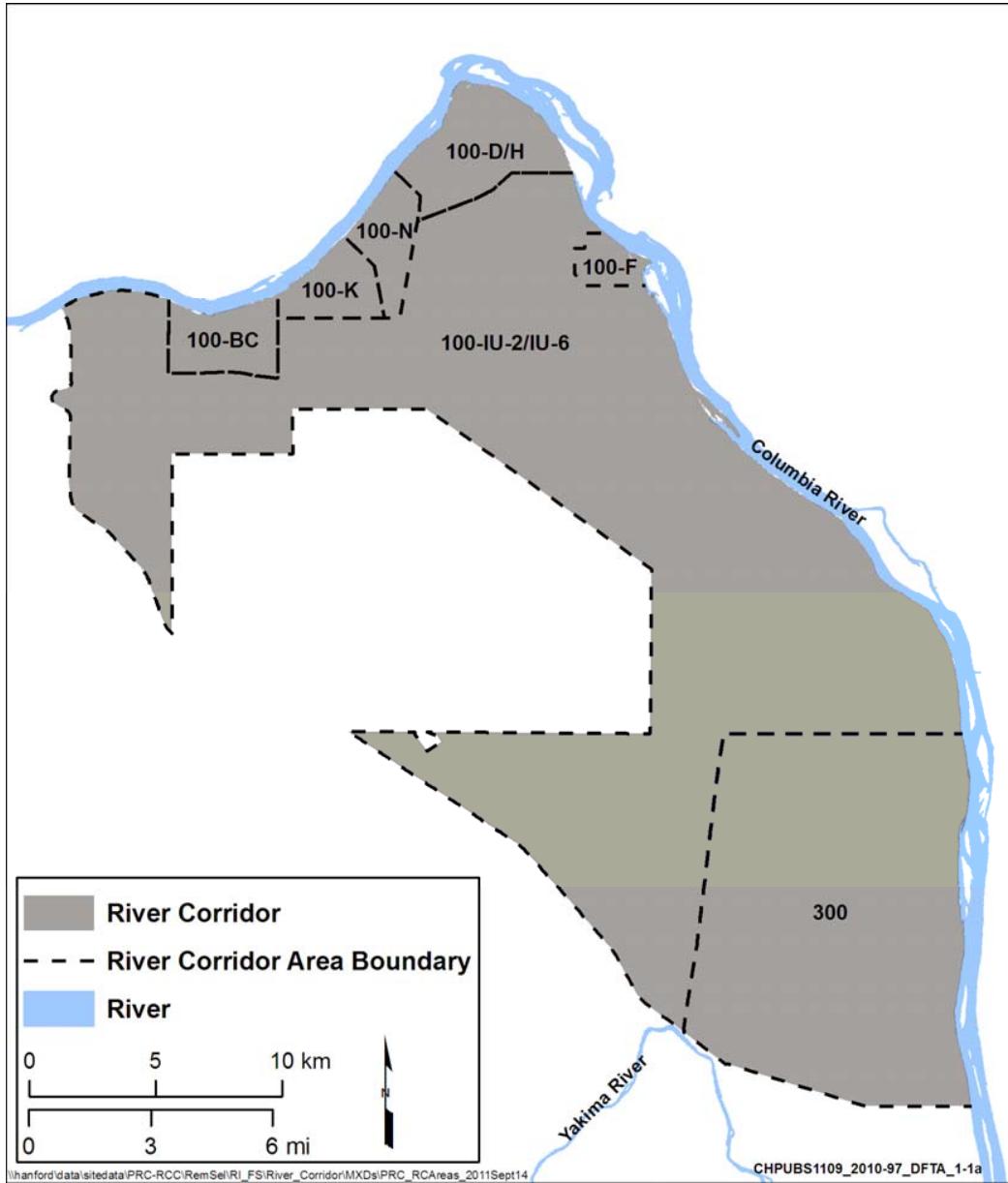


Figure 1 - River Corridor Areas

In the early 1990's the U.S. Environmental Protection Agency (EPA), the Washington State Department of Ecology (Ecology), and the U.S. Department of Energy (DOE) (known as the Tri-Parties) decided that sufficient information was known about contaminated soil and groundwater at the Hanford Site to begin cleanup with focus to protect the Columbia River. This decision led to an early start for cleanup of contaminated soil and groundwater in areas of the Hanford Site that border the river, an area known as the River Corridor.

For the purpose of remediation, the River Corridor was divided into different geographic areas: 100-BC, 100-K, 100-D, 100-H (managed as 100-D/H), 100-N, 100-F, 100-IU2, 100-IU-6 (managed as 100-F/IU-2/IU-6), and the 300 Area. These River Corridor areas are shown in Figure 1. These geographic areas include OUs, source OUs, and facilities that encompass the 100 Area NPL sites.

This cost estimate encompasses the cost of the four alternatives evaluated in the 100 BC Feasibility Study. The four FS alternatives focus on the following sites within the 100 BC area: 132-B-2; 118-B-8:3; 132-B-5; 118-B-6; 118-B-1; 1607-B5; 100-B-34; 118-B-8:1; 100-C-9:4; 100-B-22:1; and groundwater.

3 Scope of Work

The cost estimate for the 100 BC Feasibility Study project was developed in accordance with EPA/540/R-00/002, *A Guide to Developing and Documenting Cost Estimates During the Feasibility Study, OSWER 9355.0-75* (EPA, 2000), and PRC-PRO-EP-40282 Cost Estimating Procedure for Response Action Decision-Making (PRC, 2010).

Quantities used in the creation of this estimate were based on the information provided by the technical project manager in the Environmental Calculation File (ECF) document, ECF-100BC1-11-0150, Rev 1. The ECF defines quantities for the following four response action alternatives, four each Waste Site alternatives (designated by "S" before the alternative number) and four each Groundwater alternatives (designated by "GW" before the alternative number):

3.1 Waste Site Alternatives:

Four waste site alternatives are discussed below for the 10 waste sites shown in Table 1.

Table 1 - 100-BC Shallow Waste Sites

Shallow Zone Sites			
118-B-1	100-B-22:1	100-B-34	100-C-9:4
132-B-5	118-B-6	118-B-8:1	118-B-8:3
132-B-2	1607-B5		

1. Alternative S-1—No Action Alternative

The National Contingency Plan (NCP) (40 CFR 300.430(e)(6)) requires consideration of a No Action Alternative. The No Action Alternative, which services as a baseline for evaluating other remediation action alternatives, is retained throughout the FS process. No action means that no remediation would be implemented to alter the existing conditions. For this alternative, it was assumed that all site remedial activities and interim actions (with the possible exception of backfilling any open excavation for safety purposes) will be discontinued. No conceptual designs or cost estimates are prepared for Alternative 1 because no actions are proposed.

2. Alternative S-2 – Institutional Controls and Monitored Natural Attenuation

Monitored natural attenuation (MNA) and Institutional Controls (ICs) will be applied for waste site contaminants of concern (COCs).

3. Alternative S-3— Remove, Treat, Dispose (RTD), Optimized with Other Technologies

This alternative uses RTD for removal of contamination that presents an unacceptable risk to humans health from direct contact with shallow contaminated soil. Surface barriers are used at

waste sites which pose an unacceptable risk to surface water and groundwater protection and where soil removal is impeded by close proximity to a reactor.

4. Alternative S-4 – Aggressive Remove, Treat, Dispose (RTD/Excavation).

This alternative uses RTD for removal of waste site contamination to the total depth of contamination above preliminary remedial goals (PRGs). A surface barrier is used at waste site 118-B-8:1 where soil removal is impeded by close proximity to a reactor.

3.2 GW Alternatives

Four groundwater alternatives are discussed below and summarized in Table 2.

Table 2 - GW alternatives.

Table 2. 100-BC Groundwater
Alternative GW-1:No Action Alternative
Alternative GW-2: Groundwater Monitoring only – 31 existing and 11 new monitoring wells
Alternative GW-3: River Protection Pump and Treat (Moderate Action) – 31 existing and 11 new monitoring wells; 6 extraction wells; 6 injection wells.
Alternative GW-4; Aggressive Pump and Treat (More Action) – 31 existing and 11 new monitoring wells; 12 extraction wells; 12 injection wells

The following remedial action alternatives for groundwater were developed for consideration in the FS:

Groundwater Alternatives:

1. Alternative GW-1: No Action Alternative.

The National Contingency Plan (NCP) (40 CFR 300.430(e)(6)) requires consideration of a No Action Alternative, which serves as a baseline for evaluating other remediation action alternatives, is retained throughout the FS process. No action means that no remediation would be implemented to alter the existing conditions. This includes ceasing any monitoring activities. No conceptual designs or cost estimates are prepared for Alternative GW-1 because no actions are proposed.

2. Alternative GW-2: Institutional Controls and Monitored Natural Attenuation

Monitored natural attenuation (MNA) and Institutional Controls (ICs) will be applied for all groundwater contaminants of concern (COCs).

3. Alternative GW-3: River Protection Pump-and-Treat.

Groundwater pump-and-treat will be used to hydraulically contain contaminated groundwater discharge to the Columbia River and restore groundwater to levels below PRGs. Ion exchange will be used for treatment of Cr(VI) and strontium-90 contaminated groundwater. MNA and ICs will be applied to the tritium contaminated groundwater.

4. Alternative GW-4: Aggressive Pump-and Treat.

A large groundwater pump-and-treat system will be used to remove contaminated mass from the aquifer at 100-BC and restore groundwater to levels below PRGs. Ion exchange will be used for treatment of Cr(VI) and strontium-90 contaminated groundwater. MNA and ICs will be applied to the tritium contaminated groundwater.

4 Overall Costs

Starting with “Total Duration (years)”, Table 3 presents nine rows of key scope information for each alternative. The cost summary lists combined waste site plus groundwater total capital, annual, and periodic costs along with a non-discounted total for these three cost components, and the percentage that each component represents out of the non-discounted total. Total discounted costs, the discount rate used, and the corresponding order-of-magnitude discounted cost range are presented for each alternative.

Table 3 – Scope and Cost Overview for Each Alternative

	Alternative 1	Alternative 2	Alternative 3	Alternative 4
	No Action	Waste Sites & GW Limited Action	Waste Sites & GW RTD Optimized with Other Technologies	Waste Sites & GW Focused RTD and Aggressive GW Treatment
Total Waste Site Duration (years)	-	190	75	75
Total Excavated Quantity (cy)	-	0	36,969	487,274
Cap/Barrier Area (ac)	-	-	1.35	0.04
Length of pipe to grout, (LF)	-	-	0	-
Total Groundwater Extraction Rate L/min (gpm)	-	0	3974 (1050)	7097 (1875) to 3974(1050)
Total Injection Flow Rate L/min (gpm)	0	0	3974 (1050)	7097 (1875) to 3974(1050)
Total Pumping Duration (years)	0	0	65	25
Total GW Project Duration (years)	0	107	72	52
Total Waste Site Duration (years)	0	190	75	75
Cost Summary				
Capital Cost	\$0	\$382,300	\$75,918,000	\$201,602,000
Total Annual Cost	\$0	\$38,573,000	\$306,807,000	\$235,064,000
Total Periodic Cost	\$0	\$55,783,000	\$131,701,000	\$74,767,000
Non-Discounted	\$0	\$98,139,000	\$514,426,000	\$511,432,000

Real Discount Rate	-	2.0%	2.0%	2.0%
Total Present Value of Alternative (Discounted)	\$0	\$39,700,000	\$302,489,000	\$421,499,000
Expected Accuracy Range for total present value is +50%/-30%				
-30%	-	\$27,791,000	\$211,744,000	\$295,050,000
+50%	-	\$59,551,000	\$453,734,000	\$632,249,000

Table A-2 (see the appendix) presents separate summary capital, annual, periodic, total non-discounted, and total discounted (present value) costs for each of the 10 waste sites and for the 100 BC groundwater zone with assumed integrated in situ soil treatment. Totals are presented at the bottom of the table for the specific capital, annual, periodic, total non-discounted, and total discounted (present value) costs for the combined 100 BC waste sites, and then separate subtotals are presented for the combined waste sites.

5 Major Assumptions

There are two different types of assumptions and inputs for cost estimation; general and response activity specific.

5.1 General Assumptions and Inputs

General assumptions apply to all response action cost estimates. The general assumptions discussed in the sections below include direct and indirect cost assumptions and other general pricing assumptions.

1. General Direct Cost Assumptions

Direct costs include all costs that can be directly attributed to a particular construction activity or item of work required to accomplish the project. Typical direct cost items include: labor, material, equipment and subcontract items. Direct cost assumptions for this estimate include:

- Scope and bid contingencies, see Section 8
- Project management, remedial design, and construction management capital costs, see Section 9.
- Construction labor costs, see Section 15
- Equipment costs were estimated based on standard commercial estimating resources and databases: Means 2001, *ECHOS Environmental Remediation Cost Data – Unit Price*; Means 2010a, *Building Construction Cost Data*; and 2010b, *Heavy Construction Cost Data*, Richardson's *Process Plant Construction Estimating Standards*; and the *Equipment Watch Rental Rate Blue Book for Construction Equipment*. The units may have been factored or adjusted by the estimator as appropriate to reflect influences by contract, work site, or other identified project or special conditions.

- Cost impacts for performing work under specific levels of worker health safety protection:
 - Work assumed to be performed under worker health and safety level C was assumed to use the TRACE V3 overall item unit cost multiplier of 1.39 applied to the standard cost at level D. This adjustment factor corresponds to relatively favorable work conditions and predominately equipment-based tasks (e.g. operating an excavator in relatively easy work conditions as opposed to hand excavation in relatively difficult work conditions).

2. General Indirect Cost Assumptions

Indirect costs are costs not directly attributable to the completion of an activity. Indirect costs are typically allocated or spread across all activities on a predetermined basis. Indirect costs items can include the following job-related overhead items: taxes; project-specific insurance; bonds; permits and licenses; general supervision; temporary office personnel; schedules; preparatory work and testing services; temporary project facilities; temporary utilities; operations and maintenance of temporary project-site facilities; project vehicles; personal protective equipment and OSHA requirements; quality controls; mobilization and demobilization; and site security.

General indirect cost assumptions for this estimate include:

- Markups are included for profit and G&A, see Section 7
- Mobilization/demobilization and bonding/insurance – a standard TRACE V3 percentage allowance was used based on project size and using the high percentage value from the low, medium, and high percentages presented by TRACE V3 for the project size.

3. Other General Cost Assumptions

Quantities used in the cost estimate were provided by the technical team in the Environmental Calculation File, (ECF-100BC1-11-0150, Rev. 1)100-BC Cost Estimate Scoping Forms for Feasibility Study Alternative Costing. Any changes from the original quantities and any additional cost estimate basis assumptions are documented in Table A-3 (see appendix).

5.2 Response Activity-Specific Assumptions and Inputs

Assumptions specific to the proposed remedial activities for this cost estimate are described below. Quantity inputs used in the TRACE V3 cost estimating workbook are summarized in Table 6.

1. Groundwater Flow Rates

Groundwater flow rates provided by the technical team were for years 2013 through to 2078 for Alternative 3 and 2013 through 2038 for Alternative 4. The flow rates for Alternative 3 and Alternative 4 were constant over the entire periods for Cr(VI) and Sr-90 treatment systems. Table A-5 provides information on the groundwater flow rates for the different time periods.

2. Summary of Cost by Site:

The costs for the alternatives for 100 BC were calculated by alternative as a total cost, with itemized waste site costs and itemized groundwater remediation costs combined into each alternative. Separate costs for each of the ten waste sites and for the groundwater remediation were spilt out and summarized from the alternative total costs by the following:

- Breaking out and summing each of the site-specific costs for each site
- Allocating a portion of the overall mobilization/demobilization/bonding/insurance, site preparation, and alternative markup costs to each specific site based on the site subtotal cost of the overall alternative cost

Quantity assumptions and inputs for the cost estimate are described in the 100 BC ECF document.

3. Modified Standard TRACE V3 Unit Costs

The following unit costs were used in the cost estimate and were added to or modified from the original TRACE V3 default costs. The source of the unit cost is listed beside the item in the list below:

Table 4 - Modified TRACE V3 Unit Costs

Demolition subcontractor for stack removal	\$891,167/LS	Detailed estimated cost
Sampling during removal of stack	\$51,851/LS	Detailed estimated cost
PRC support during removal and RTD of stack	\$549,987/LS	Detailed estimated cost
Annual Inspection of the Waste Site	\$500/yr	Based on \$1,500/yr marked up actual cost from Hanford historical costs
Delivered and spread 27 cy of soil to small waste site	\$5,000/LS	Estimated cost
Well (4" DIA) installation cost, deep (>100 ft bgs)	\$734/ft	Modified to account for the Level C safety level during Excavation (multiplied the default TRACE unit cost by 1.39)
Well (8" DIA) installation costs, deep (>100 ft bgs)	\$1,058/ft	Modified to account for the Level C safety level during Excavation (multiplied the default TRACE unit cost by 1.39)
Well (8" DIA), rehab cost	\$388/ft	Modified to account for the Level C safety level during Excavation (multiplied the default TRACE unit cost by 1.39)
Well (4" DIA) replacement cost, deep (>100 ft bgs)	\$734/ft	Modified to account for the Level C safety level during Excavation

		(multiplied the default TRACE unit cost by 1.39)
Well (8" DIA) replacement costs, deep (>100 ft bgs)	\$1,058/ft	Modified to account for the Level C safety level during Excavation (multiplied the default TRACE unit cost by 1.39)
Abandon Monitoring Well	\$5,936/each	Modified to account for the Level C safety level during Excavation (multiplied the default TRACE unit cost by 1.39)
Abandon Extraction or Injection Well	\$8,857/each	Modified to account for the Level C safety level during Excavation (multiplied the default TRACE unit cost by 1.39)

Decommissioning and Removal of Treatment Systems (for ALTs 3 & 4) – based on TRACE standard 30% allowance of original construction cost

Site Preparation – estimator's judgment at \$100,000 for groundwater Alternative 2, \$250,000 for groundwater Alternative 3, and \$500,000 for groundwater Alternative 4, and \$175,000 for waste site Alternative 3 and \$300,000 for waste site Alternative 4

The following TRACE V3 unit costs were modified by using a TRACE 1.39 multiplier to account for Level C:

- Well drilling for monitoring, injection & extraction wells
- Well rehabilitation for injection & extraction wells
- Well replacement for monitoring, injection & extraction wells
- Well abandonment for monitoring, injection & extraction wells

4. Specific assumptions

The following specific assumptions were used for the groundwater or waste site alternatives:

- Well abandonment – every 20 years for extraction wells and every 10 years for injection wells.
- Well replacement – every 20 years for extraction wells and every 10 years for injection wells.
- Well rehabilitations – every 10 years for extraction wells and every 2 years for injection wells.
- Replacement of in-well groundwater pumps – every 5 years.
- Excavation – density of soil, assumed 1.5 tons per bank cy

5. Alternative Specific Assumptions Used in Estimate

The following is a list detailing the assumptions that were utilized in performing the cost estimates.

a. Groundwater Assumptions:

Specific assumptions for the GW portion of the alternatives are based on data for the 100-HR3 operable unit, as presented in Chapter 9 of DOE/RL-2010-95. Please see Table A-2 in the Appendix for the alternative specific waste site assumptions and Table A-5 for the groundwater alternative specific assumptions.

Site: 100-B/C-5

The following assumptions are based on Chapter 9 of DOE/RL-2010-96

GW Alternative 1- No Action

- No Action

GW Alternative 2- Less Action

- MNA, included on BC_GW_MNA2.xlsx

GW Alternative 3 – Moderate Action

- Pump and treat with Ex-Situ ion exchange treatment on BC_GW_IonExchange1.xlsx
- 6 extraction wells – average 200 feet deep, 8-inch steel casing, 75 gpm production rate per well, included on BC_GW_ExtractionWells1.xlsx
- 6 injection wells – average 200 feet deep, 8-inch steel well casing, 75 gpm injection rate per well, included on BC_InjectionWells1.xlsx
- For well rates see BC5_RIFS_wells.xlsx

GW Alternative 4 – More Action

- Pump and Treat with Ex-situ ion exchange treatment of CrVI and Sr-90 included on BC_GW_InjectionWells1.xlsx, BC_GW_ExtractionWells1.xlsx and BC_GW_IonExchange1.xlsx
- 12 extraction wells – average 200 feet deep, 8-inch steel casing, 75 gpm production rate per well included on BC_GW_ExtractionWells1.xlsx
- 12 injection wells – average 200 feet deep, 8-inch steel well casing, 75 gpm injection rate per well included on BC_GW_InjectionWells1.xlsx
- For well rates see BC5_RIFS_wells.xlsx

Waste Site Assumptions:

VZ Alternative 1- No Action:

- No action for all Waste Sites.

VZ Alternative 2- Institutional Controls and Natural Attenuation:

The following assumptions are based on information provided in Chapter 9 and Appendix J of DOE/RL-2010-96

Site 118-B-1: CVP deep zone footprint, deep direct exposure/tritium

- Institutional Controls, site inspection

Site 100-B-22:1: pipelines, Waste Site Remaining for Remedial Action

- Institutional Controls, site inspection

Site 100-B-34: contaminated soil, pipeline, Waste Site Remaining for Remedial Action

- Institutional Controls, site inspection

Site 100-C-9:4: pipelines,

- Institutional Controls, site inspection

Site 132-B-5: subgrade footprint

- Institutional Controls, site inspection

Site 118-B-6: contaminated soil,

- Institutional Controls, site inspection

Site 118-B-8:1: contaminated soil,

Institutional Controls, site inspection

Site 118-B-8:3: Pipeline

- Institutional Controls, site inspection

Site 132-B-2: Stack

- Institutional Controls, site inspection

Site 1607-B5: contaminated soil, pipeline, tank, Waste Site Remaining for Remedial Action

- Institutional Controls, site inspection

VZ Alternative 3- Remove, Treat, Dispose (RTD), Optimized with Other Technologies:

The following assumptions are based on information provided in Chapter 9 and Appendix J of DOE/RL-2010-96

Site 118-B-1: CVP deep zone footprint, deep direct exposure/tritium plume

- Capping with an Evapotranspiration Cap

Site 100-B-22:1: pipelines, Waste Sites Remaining for Remedial Action

- RTD to total contamination depth

Site 100-B-34: contaminated soil, pipeline, Waste Sites Remaining for Remedial Action RTD to total contamination depth

- RTD to total contamination depth

Site 100-C-9:4: pipelines, Post-ROD To Go

- RTD to total contamination depth

Site 132-B-5: subgrade footprint

- Minimal Design Sampling, follow rule of thumb for confirmation/verification sampling
- RTD to total contamination

Site 118-B-6: CVP deep zone footprint, deep direct exposure/tritium plume

- Capping with an Evapotranspiration Cap

Site 118-B-8:1: contaminated soil, Post-ROD To Go

- Capping with an Asphalt Cap

Site 118-B-8:3: Pipeline

- Institutional Controls

Site 132-B-2: stack

- Institutional Controls

Site 1607-B5: contaminated soil, pipeline, tank, Waste Sites Remaining for Remedial Action

- Minimal Design Sampling, follow rule of thumb for confirmation/verification sampling
- RTD to total contamination

VZ Alternative 4- Aggressive Remove, Treat, Dispose (RTD/Excavation):

Site 118-B-1: CVP deep zone footprint, deep direct exposure/tritium

- Minimal Design Sampling, follow rule of thumb for confirmation/verification sampling
- RTD to total contamination depth

Site 100-B-22:1: pipelines, Waste Sites Remaining for Remedial Action

- RTD to total contamination depth

Site 100-B-34: contaminated soil, pipeline, Waste Sites Remaining for Remedial Action

- Minimal Design Sampling, follow rule of thumb for confirmation/verification sampling
- RTD to total contamination depth

Site 100-C-9:4: pipelines,

- Minimal Design Sampling, follow rule of thumb for confirmation/verification sampling
- RTD to total contamination depth

Site 132-B-5: subgrade footprint

- Minimal Design Sampling, follow rule of thumb for confirmation/verification sampling
- RTD to total contamination depth

Site 118-B-6: contaminated soil,

- Minimal Design Sampling, follow rule of thumb for confirmation/verification sampling,
- RTD to total contamination depth

Site 118-B-8:1: contaminated soil, Post-ROD To Go

- Capping with an Asphalt Cap

Site 118-B-8:3: Pipeline

- RTD to Total Depth above PRGs

Site 132-B-2: Stack

- RTD to Total Depth above PRGs and demo the stack

Site 1607-B5: contaminated soil, pipeline, tank, Waste Sites Remaining for Remedial Action

- Minimal Design Sampling, follow rule of thumb for confirmation/verification sampling
- RTD to total contamination depth

6 Exclusions

This section identifies costs that have not been included in the estimate. The following items have been excluded from the estimate:

- Escalation – Separate escalation has not been included in these calculations. The costs are all based on fiscal year 2012 costs distributed into years that the activities and associated costs would occur, and a present value (PV) analysis is performed to convert all costs back to fiscal year 2012 basis using the alternative-specific stated OMB real discount rate.
- Costs for remediating the sites individually under separate contracts. The costs in this estimate assume that the sites are remediated under one contract corresponding to the specific alternative, or at most one vadose zone and one groundwater contract. If the sites are remediated separately, the individual site costs would be expected to be higher than shown for the individual sites in Table A-2, since certain fixed costs would not be spread over a group of sites and certain activity economies of scale would not be present.

- The following tasks are assumed to be part of the program scope of the overall Hanford Remediation Project and therefore are not included in this RI/FS alternatives estimate:
 - Five year review and preparation reporting
 - Institutional Controls
 - Maintenance and operations of the excavation permit program
 - Deed maintenance, zoning restrictions, and legal costs, signage and access to waste sites
 - Site security

7 Markups

The following markups have been included in the Cost Estimate:

- Contractor Overhead at 10 percent.
- Contractor Profit at 8 percent.
- PRC general and administrative (G&A) costs have been applied at a rate of 30.24¹ percent to all PRC labor, material, and equipment. G&A is also applied to the FP contractor costs. This markup includes a number of job-related overhead items:
 - Taxes
 - Project-specific insurance
 - Bonds
 - Permits and licenses
 - General supervision
 - Temporary office personnel
 - Schedules
 - Preparatory work and testing services
 - Temporary project facilities and O&M of these facilities
 - Temporary utilities (e.g. phone, electrical)
 - Project vehicles
 - Personal protective equipment and Occupational Health and Safety requirements
 - Quality controls
 - Mobilization and demobilization
 - Site security

8 Contingencies

Contingency is factored into a cost estimate to cover unknowns, unforeseen circumstances, or unanticipated conditions that are not possible to evaluate from the available data at the time the estimate is prepared. It is used to reduce the risk of possible cost overruns.

The two main types of contingency are scope and bid. Scope contingency covers unknown costs due to scope changes that may occur during design. Bid contingency covers unknown costs associated with

¹ G&A rate is obtained from CH2M Hill Plateau Remediation Company FY12 – (provisional approval granted)
<http://prc.rl.gov/rapidweb/finance/index.cfm?pagenum=11>

constructing and implementing a given project scope. The range for bid contingency is typically from 10 to 20%.

1. Scope Contingency. Scope contingency rates have been applied to the capital costs for Alternatives 2, 3, and 4 as per EPA/540/R-00/002, Section 5.4: 35% for the waste sites, 20% for groundwater alternative 2 and 25% for groundwater alternative's 3 &4.
2. Bid Contingency. The range for bid contingency is typically from 10 to 20%. The bid contingency for this estimate has been set at 20% for the waste sites and 20% for the groundwater.
3. O&M Contingency. The O&M contingency has been estimated to be 40% for all waste site alternatives, 30% for groundwater Alternative 2, and 20% for groundwater Alternatives 3&4.

9 Project Management, Remedial Design, and Construction Management Costs

Project management, remedial design, and construction management capital costs are estimated using factors based on EPA/540/R-00/002, Exhibit 5-8. used:

- For projects with construction costs less than \$100,000 – remedial design is planned at 20%, project management is planned at 10%, and construction management is planned at 15% of the construction cost.
- For projects with construction costs from \$100,000 to \$500,000 – remedial design is planned at 15%, project management is planned at 8%, and construction management is planned at 10% of the construction cost.
- For projects with construction costs from \$500,000 to \$2 million – remedial design is planned at 12%, project management is planned at 6%, and construction management is planned at 8% of the construction cost.
- For projects with construction costs from \$2 million to \$10 million – remedial design is planned at 8%, project management is planned at 5%, and construction management is planned at 6% of the construction cost.
- For projects with construction costs greater than \$10 million – remedial design is planned at 6%, project management is planned at 5%, and construction management is planned at 6% of the construction cost.

10 Present Worth

As per EPA Guidance, EPA/540/R-00/002, *A Guide to Developing and Documenting Cost Estimates During the Feasibility Study*, OSWER 9355.0-75 (EPA, 2000) the estimate includes present worth calculations for work performed in out years.

The costs are presented as present worth values. The present worth value method establishes a common baseline for evaluating costs that occur during different time periods, thus allowing for direct cost comparisons between different alternatives. The present worth value represents the dollars that would

need to be set aside today, at the defined real discount rate, to ensure that funds would be available in the future as they are needed to perform the response action alternative.

Present worth costs were estimated using the real discount rate published in Appendix C of the Office of Management and Budget (OMB) Circular No. A-94, *Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs, effective October 2012* (OMB, 2012). Based on this guidance and Alternative 2 durations of 190 years (waste sites) and 107 years (groundwater), Alternative 3 durations of 75 years (waste sites) and 72 years (groundwater), and Alternative 4 durations of 75 years (waste sites) and 52 years (groundwater), a real discount rate of 2.0 percent was used in cost estimate present value calculations for all three alternatives.

11 Estimate Classification

This estimate was prepared in accordance with the guidelines of "[A Guide to Developing and Documenting Cost Estimates During the Feasibility Study, EPA 540-R-00-002, OSWER 9355.0-75, July 2000](#)". It's important to remember that at the FS stage, the design for the response action project is still conceptual, not detailed, and the cost estimate is considered to be "order-of-magnitude." The expected accuracy range of the cost estimate at this stage is approximately plus 50 percent, minus 30 percent.

The expected accuracy range is an indication of the degree to which the final cost outcome for a given project could vary from the estimated cost. Accuracy is traditionally expressed as a +/- percentage range around the point estimate after application of contingency, with a stated level of confidence that the actual cost outcome would fall within this range (+/- measures are a useful simplification, given that actual cost outcomes have different frequency distributions for different types of projects). Typically, this results in a 90% confidence that the actual cost will fall within the bounds of the low and high ranges.

The accuracy range of an estimate is dependent upon a number of characteristics of the estimate input information and the estimating process. The extent and the maturity of the input information as measured by percentage completion (and related to level of project definition) is an important determinant of accuracy. However, there are factors besides the available input information that also greatly affect estimate accuracy measures. Primary among these are the state of technology in the project and the quality of reference cost estimating data.

The accuracy of any given estimate is not fixed or determined by its classification category. Significant variations in accuracy from estimate to estimate are possible if any of the determinants of accuracy, such as technology, quality of reference cost data, quality of the estimating process, and skill and knowledge of the estimator vary. Accuracy is also not necessarily determined by the methodology used or the effort expended. Estimate accuracy must be evaluated on an estimate-by estimate basis, usually in conjunction with some form of risk analysis process.

12 Cost Resources

The following is a list of the cost resources used in the development of the cost estimate.

- TRACE V3 (ECF-11-0164, ECF-Hanford-11-0098 through 0107, including ECFs for previous PCRAD and updated TRACE)
- RS Means

- Hanford historical actual costs
- Estimator Judgment

13 Estimate Methodology

The cost estimate for the 100 BC project was developed in accordance with EPA/540/R-00/002, *A Guide to Developing and Documenting Cost Estimates During the Feasibility Study*, OSWER 9355.0-75 (EPA, 2000), and PRC-PRO-EP-40282 *Cost Estimating Procedure for Response Action Decision-Making* (PRC, 2010). The TRACE V3 cost estimating workbook in conjunction with the RACER™ Cost Estimator software were used to develop the cost estimate for each of the removal action alternatives.

This cost estimate has been prepared for guidance in project evaluation from the information available at the time of the estimate. The final cost of the project will depend on final design, selected scope of work, actual labor and material costs, competitive market conditions, implementation schedule and other variable factors. As a result, the final project costs will vary from the estimate presented here. Because of this, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions to help ensure proper project evaluation and adequate funding.

14 Sensitivity Analysis

Sensitivity analysis for this cost estimate was not performed. The following factors might cause the estimate to significantly change.

- *Levels of contamination*
- *Depth and extent of contamination encountered during RTD of vadose Zone sites*
- *Rate(s) of groundwater extraction and injection*
- *Duration of extraction and injection systems*
- *Duration and actual operations and maintenance requirements for groundwater treatment systems*
- *Less favorable working conditions and/or increased monitoring requirements that would significantly increase the impact of working in health and safety protection and/or increase the health and safety protection requirements.*

Because of these factors:

1. The remedy selection process must consider differences in response action cost uncertainties/cost risks in addition to response action-specific cost estimates and ranges.
2. Funding needs must be carefully reviewed before making specific financial decisions or establishing final budgets.

15 Labor Costs

Fixed-price (FP) construction craft labor rates are those listed in Appendix A of the Site Stabilization Agreement for All Construction Work for the U.S. Department of Energy at the Hanford Site (commonly

known as the Hanford Site Stabilization Agreement [HSSA]). The HSSA rates include base wage, fringe benefits, and other compensation as negotiated between CH2M HILL Plateau Remediation Company (CHPRC) and the National Building and Construction Trades Department American Federation of Labor-Congress of Industrial Organizations (AFL-CIO). Other factors that account for additional costs (Workman's Compensation, Federal Insurance Contributions Act (FICA), and state and Federal unemployment insurance) to develop a fully burdened rate by craft, have been incorporated. The labor rates used are for 2011.

Plateau Remediation Contractor (PRC) labor rates for management, engineering, safety oversight, and technical support are based on the PRC-approved planning rates for fiscal year 2011.

16 Sales Tax

Washington State sales tax has been applied to all estimated material and equipment purchases at 8.3 percent and is included in the PRC general and administrative (G&A) percentage discussed in section 5.

17 References

- EPA 540-R-00-002, 2000, *A Guide to Developing and Documenting Cost Estimates During the Feasibility Study*, OSWER 9355.0-75, Office of Emergency and Remedial Response, U.S. Environmental Protection Agency, Washington, D.C.
- PRC-PRO-EP-40282, 2010, *Cost Estimating Procedure for Response Action Decision-Making*, Rev. 0, Chg. 0, CH2M HILL Plateau Remediation Company, Richland, Washington.
- Means, R. S., 2001, *ECHOS Environmental Remediation Cost Date Unit Price*, Robert S. Means Company, Kingston, Massachusetts.
- Means, R. S., 2010a, *Building Construction Cost Book*, 68th annual ed., Robert S. Means Company, Kingston, Massachusetts.
- Means, R. S., 2010b, *Heavy Construction Cost Data*, 24th annual ed., Robert S. Means Company, Kingston, Massachusetts.
- OMB Circular No. A-94, 2012, "Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs" (memorandum for Heads of Executive Departments and Establishments), Appendix C, "Discount Rates for Cost-Effectiveness, Lease Purchase, and Related Analyses," as revised, Office of Management and Budget, Washington, D.C.
- Site Stabilization Agreement for All Construction Work for the U.S. Department of Energy at the Hanford Site*, 1984, as amended, commonly known as the Hanford Site Stabilization Agreement (HSSA)(original title, *Site Stabilization Agreement, Hanford Site, between J.A. Jones Construction Services Company and Morrison-Knudsen Company, Inc., and the Building and Construction Trades Department of the AFL-CIO and its affiliated international unions, and the International Brotherhood of Teamsters, Chauffeurs, Warehousemen, and Helpers of America*).

ECF-Hanford-11-0164, Environmental Calculation File TRACEV3 – Site Cost Distribution

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- ECF-Hanford-11-0098, Environmental Calculation File for TRACE_V3_Overview (Rev1)
- ECF-Hanford-11-0099, Environmental Calculation File for TRACE_V3-Actual_Costs, (Rev1)
- ECF-Hanford-11-0100, Environmental Calculation File for TRACE_V3-RACER_Costs (Rev1)
- ECF-Hanford-11-0101, Environmental Calculation File for TRACE_V3-Calculations (Rev1)
- ECF-Hanford-11-0102 Environmental Calculation File for TRACE_V3-Unit_Costs (Rev1)
- ECF-Hanford-11-0103, Environmental Calculation File for TRACE_V3-Capital_Cost (Rev1)
- ECF-Hanford-11-0104, Environmental Calculation File for TRACE_V3-O&M_Cost (Rev1)
- ECF-Hanford-11-0105, Environmental Calculation File for TRACE_V3-O&M_Distribution (Rev1)
- ECF-Hanford-11-0106, Environmental Calculation File for TRACE_V3-Present_Value (Rev1)
- ECF-Hanford-11-0107, Environmental Calculation File for TRACE_V3-Totals (Rev1)
- ECF-Hanford-11-0037, Environmental Calculation File for Excavation Template_V1

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Appendix

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Table A-1: Waste Site Totals

COMPARISON OF TOTAL COST OF RESPONSE ACTION ALTERNATIVES*

Site:	100 BC	100 BC	Base Year:	2013
Location:	Hanford, WA	Hanford, WA	Date:	July-12
Phase:	FS	FS	Rev:	1

	S-1	S-2	S-3	S-4
	No Action	MESC, MNA, and ICs	VZ Only - RTD Optimized with Other Technologies	Aggressive RTD
Total Duration (years)	0	190	75	75

Cost Summary

Capital Cost	\$0	\$0	\$19,079,000	\$105,492,000
% of Total Non-discounted cost	-	0.00%	92.39%	99.66%
Total Annual Cost	\$0	\$1,505,000	\$638,000	\$128,000
% of Total Non-discounted cost	-	55.97%	3.09%	0.12%
Total Periodic Cost	\$0	\$1,184,000	\$934,000	\$233,000
% of Total Non-discounted cost	-	44%	5%	0%
Non-Discounted	\$0	\$2,689,000	\$20,651,000	\$105,853,000
Real Discount Rate	-	2.0%	2.0%	2.0%
Total Present Value of Alternative (Discounted)	-	\$911,000	\$19,323,000	\$103,570,000

Expected Accuracy Range for total present value is +50%/-30%

-30%	-	\$638,000	\$13,527,000	\$72,499,000
50%	-	\$1,367,000	\$28,985,000	\$155,355,000

*Notes:

Range of accuracy is expected to be +50%/-30%

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Table A-2: Waste site Cost Summary

	HH-2 Limited Action	HH-3 RTD Optimized with Other Technologies	HH-4 Focused RTD and Aggressive GW Treatment
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Site number 4					
Site name	Site 132-B-5: subgrade footprint				
Capital Cost	\$ -	\$ 4,671,000	\$	4,671,000	
Annual	\$ 255,000	\$ -	\$	-	
Periodic	\$ 119,000	\$ -	\$	-	
Individual Site (Non Discounted)	\$ 374,000	\$ 4,671,000	\$	4,671,000	
Discounted (PV)	\$ 86,000	\$ 4,580,000	\$	4,580,000	

Site number 7					
Site name	Site 118-B-8:3				
Capital Cost	\$ -	\$ -	\$	948,480	
Annual	\$ 127,500	\$ 127,500	\$	-	
Periodic	\$ 118,300	\$ 118,300	\$	-	
Individual Site (Non Discounted)	\$ 245,800	\$ 245,800	\$	948,480	
Discounted (PV)	\$ 90,727	\$ 90,727	\$	929,882	

Site number 8					
Site name	Site 118-B-1: CVP deep zone footprint, deep direct exposure				
Capital Cost	\$ -	\$ 1,148,366	\$	75,100,502	
Annual	\$ 127,500	\$ 127,500	\$	-	
Periodic	\$ 118,300	\$ 232,400	\$	-	
Individual Site (Non Discounted)	\$ 245,800	\$ 1,508,266	\$	75,100,502	
Discounted (PV)	\$ 90,727	\$ 1,271,303	\$	73,627,944	

Site number 9					
Site name	Site 1607-B5: contaminated soil, pipeline, tank				
Capital Cost	\$ -	\$ 1,039,933	\$	1,039,933	
Annual	\$ 127,500	\$ -	\$	-	
Periodic	\$ 118,300	\$ -	\$	-	
Individual Site (Non Discounted)	\$ 245,800	\$ 1,039,933	\$	1,039,933	
Discounted (PV)	\$ 90,727	\$ 1,019,542	\$	1,019,542	

Site number 10					
Site name	Site 100-B-34: contaminated soil, pipeline				
Capital Cost	\$ -	\$ 1,354,846	\$	1,354,846	
Annual	\$ 127,500	\$ -	\$	-	
Periodic	\$ 118,300	\$ -	\$	-	
Individual Site (Non Discounted)	\$ 245,800	\$ 1,354,846	\$	1,354,846	
Discounted (PV)	\$ 90,727	\$ 1,328,280	\$	1,328,280	

Site number 11					
Site name	Site 118-B-8:1: contaminated soil				
Capital Cost	\$ -	\$ 109,518	\$		109,518
Annual	\$ 323,000	\$ 127,500	\$		127,500
Periodic	\$ 118,300	\$ 232,400	\$		232,400
Individual Site (Non Discounted)	\$ 441,300	\$ 469,418	\$		469,418
Discounted (PV)	\$ 84,092	\$ 252,824	\$		252,824

Site number 13					
Site name	100-C-9:4				
Capital Cost	\$ -	\$ 4,885,382	\$		4,885,382
Annual	\$ 127,500	\$ -	\$		-
Periodic	\$ 118,300	\$ -	\$		-
Individual Site (Non Discounted)	\$ 245,800	\$ 4,885,382	\$		4,885,382
Discounted (PV)	\$ 90,727	\$ 4,789,590	\$		4,789,590

Site number 14					
Site name	Site 100-B-22:1				
Capital Cost	\$ -	\$ 5,778,869	\$		5,778,869
Annual	\$ 127,500	\$ -	\$		-
Periodic	\$ 118,300	\$ -	\$		-
Individual Site (Non Discounted)	\$ 245,800	\$ 5,778,869	\$		5,778,869
Discounted (PV)	\$ 90,727	\$ 5,665,558	\$		5,665,558

Site number 15					
Site name	132-B-2				
Capital Cost	\$ -	\$ -	\$		4,723,026
Annual	\$ 127,500	\$ 127,500	\$		-
Periodic	\$ 118,300	\$ 118,300	\$		-
Individual Site (Non Discounted)	\$ 245,800	\$ 245,800	\$		4,723,026
Discounted (PV)	\$ 90,727	\$ 90,727	\$		4,630,417

Site number 16					
Site name	118-B-6				
Capital Cost	\$ -	\$ 90,604	\$		6,880,090
Annual	\$ 34,000	\$ 127,500	\$		-
Periodic	\$ 118,300	\$ 232,400	\$		-
Individual Site (Non Discounted)	\$ 152,300	\$ 450,504	\$		6,880,090
Discounted (PV)	\$ 105,304	\$ 234,281	\$		6,745,187

Table A-3: Waste Site Quantities

TABLE 1-1 - Setup

	B	C	D	E
1298	IMPORTANT QUANTITIES	2	3	4
1299	Alternative Name	Limited Action	RTD Optimized with Other Technologies	Focused RTD and Aggressive GW Treatment
1300	Cap/Barrier		X	
1301	118-B-6	NA	D (Non Hazardous Waste)	
1302	Cap Type	NA	0.014	
1303	Area, ac	NA	D	
1304	Safety Level	NA	ET	
1305	Type	NA	X	
1306	118-B-1	NA	1.30	
1307	Cap Type	NA	D (Non Hazardous Waste)	
1308	Area, ac	NA	D	
1309	Safety Level	NA	ET	
1310	Type	NA	X	
1311	118-B-8:1	NA	RCRA D (Non Hazardous Waste)	
1312	Cap Type	NA	RCRA D (Non Hazardous Waste)	
1313	Area, ac	NA	0.04	0.04
1314	Safety Level	NA	D	D
1315	Type	NA	ET	ET
1316	Excavation			
1353	132-B-5	x	x	
1354	Area, ac	NA	0.380	0.380
1355	Depth, ft	NA	10.800	10.800
1356	Depth to Top of Contamination	NA	3.300	3.300
1357	Expected Safety Level	NA	D	D
1358	Existing Cover	NA	Soil/Gravel	Soil/Gravel
1359	Replacement Cover	NA	Soil/Stone	Soil/Stone
1360	Waste Site Base Area (sf)	NA	16,552.80	16,552.80
1361	Waste Site Ground Surface Area (sf)	NA	25,939.58	25,939.58
1362	Total Volume of Excavation (cy)	NA	9,773.25	9,773.25
1363	Total Volume Contaminated (cy)	NA	5,287.70	5,287.70
1364	Total Volume of Overburden for Reuse	NA	4,485.55	4,485.55
1389	1607-B5	x	x	
1390	Area, ac	NA	0.026	0.026
1391	Depth, ft	NA	11.500	11.500
1392	Depth to Top of Contamination	NA	0.000	0.000
1393	Expected Safety Level	NA	D	D
1394	Existing Cover	NA	Soil/Gravel	Soil/Gravel
1395	Replacement Cover	NA	Soil/Stone	Soil/Stone
1396	Waste Site Base Area (sf)	NA	1,132.56	1,132.56
1397	Waste Site Ground Surface Area (sf)	NA	4,644.90	4,644.90
1398	Total Volume of Excavation (cy)	NA	1,414.94	1,414.94
1399	Total Volume Contaminated (cy)	NA	554.74	554.74
1400	Total Volume of Overburden for Reuse	NA	860.20	860.20
1401	100-C-9:4	x	x	
1402	Area, ac	NA	0.000	0.230
1403	Depth, ft	NA	0.000	16.000
1404	Depth to Top of Contamination	NA	0.000	3.300
1405	Expected Safety Level	NA	D	D
1406	Existing Cover	NA	Soil/Gravel	Soil/Gravel
1407	Replacement Cover	NA	Soil/Stone	Soil/Stone
1408	Waste Site Base Area (sf)	NA	10,018.80	10,018.80
1409	Waste Site Ground Surface Area (sf)	NA	21,931.82	21,931.82
1410	Total Volume of Excavation (cy)	NA	10,886.88	10,886.88
1411	Total Volume Contaminated (cy)	NA	5,419.43	5,419.43
1412	Total Volume of Overburden for Reuse	NA	5,467.45	5,467.45

TABLE 1-1 - Setup

B	C	D	E
1413 100-B-22:1		x	x
1414 Area, ac	NA	0.833	0.833
1415 Depth, ft	NA	6.900	6.900
1416 Depth to Top of Contamination	NA	0.000	0.000
1417 Expected Safety Level	NA	D	D
1418 Existing Cover	NA	Soil/Gravel	Soil/Gravel
1419 Replacement Cover	NA	Soil/Stone	Soil/Stone
1420 Waste Site Base Area (sf)	NA	36285.836	36,285.84
1421 Waste Site Ground Surface Area (sf)	NA	44600.546	44,600.55
1422 Total Volume of Excavation (cy)	NA	11,886	11,885.80
1423 Total Volume Contaminated (cy)	NA	10,664	10,664.00
Total Volume of Overburden for Reuse (cy)	NA	1221.800	1,221.80
1425 118-B-1			x
1426 Area, ac	NA	NA	1.350
1427 Depth, ft	NA	NA	72.000
1428 Depth to Top of Contamination	NA	NA	16.000
1429 Expected Safety Level	NA	NA	D
1430 Existing Cover	NA	NA	Soil/Gravel
1431 Replacement Cover	NA	NA	Soil/Stone
1432 Waste Site Base Area (sf)	NA	NA	58,806.00
1433 Waste Site Ground Surface Area (sf)	NA	NA	210,221.78
1434 Total Volume of Excavation (cy)	NA	-	412,509.26
1435 Total Volume Contaminated (cy)	NA	-	140,263.20
Total Volume of Overburden for Reuse (cy)	NA	NA	272,246.06
1436 100-B-34			x
1438 Area, ac	NA	0.020	0.020
1439 Depth, ft	NA	18.000	18.000
1440 Depth to Top of Contamination	NA	5.900	5.900
1441 Expected Safety Level	NA	D	D
1442 Existing Cover	NA	Soil/Gravel	Soil/Gravel
1443 Replacement Cover	NA	Soil/Stone	Soil/Stone
1444 Waste Site Base Area (sf)	NA	871.200	871.20
1445 Waste Site Ground Surface Area (sf)	NA	6974.939	6,974.94
1446 Total Volume of Excavation (cy)	NA	3007.686	3,007.69
1447 Total Volume Contaminated (cy)	NA	448.99	448.99
Total Volume of Overburden for Reuse (cy)	NA	2558.696	2,558.70
1461 118-B-6			
1462 Area, ac	NA	NA	0.014
1463 Depth, ft	NA	NA	52.500
1464 Depth to Top of Contamination	NA	NA	0.000
1465 Expected Safety Level	NA	NA	D
1466 Waste Site Base Area (sf)	NA	NA	609.84
1467 Waste Site Ground Surface Area (sf)	NA	0.000	33,195.00
1468 Total Volume of Excavation (cy)	NA	-	37,795.68
1469 Total Volume Contaminated (cy)	NA	NA	3,779.57
1470			

Table A-4: Groundwater Totals

	B	D	E	F
2	COMPARISON OF TOTAL COST OF RESPONSE ACTION ALTERNATIVES*			
4	Site: 100BC	Base Year: 2013		
5	Location: Hanford, WA	Date: August-12		
6	Phase: FS	Rev: 2		
8		Alternative 2	Alternative 3	Alternative 4
9		GW Alternative 2 - Less Action	GW Alternative 3 - Moderate Action	GW Alternative 4 - More Action
10	Total Duration (years)	107	72	52
11	P&T Duration, years	NA	65	25
12	Existing Monitoring Wells	31	31	31
13	New Monitoring Wells	11	11	11
15	Extraction Wells	NA	6	12
16	Injection Wells	NA	6	12
17	Cr(VI) IX Treatment Flow, gpm	NA	450	900
18	Sr-90 IX Treatment Flow Rate, gpm	NA	150	300
36	Cost Summary			
37	Capital Cost	\$3,823,000	\$56,839,000	\$96,110,000
38	% of Total Non-discounted cost	4.01%	11.51%	23.70%
39	Total Annual Cost	\$37,068,000	\$306,169,000	\$234,936,000
40	% of Total Non-discounted cost	38.83%	62.01%	57.93%
41	Total Periodic Cost	\$54,559,000	\$130,767,000	\$74,534,000
42	% of Total Non-discounted cost	57%	26%	18%
43	Non-Discounted	\$95,450,000	\$493,775,000	\$405,579,000
44	Real Discount Rate	2.0%	2.0%	2.0%
45	Total Present Value of Alternative (Discounted)	\$38,789,000	\$283,166,000	\$317,929,000
46	Expected Accuracy Range for total present value is +50%/-30%			
47	-30%	\$27,153,000	\$198,217,000	\$222,551,000
48	50%	\$58,184,000	\$424,749,000	\$476,894,000
49				
50	*Notes:			
51	Range of accuracy is expected to be +50%/-30%			
52				

Table A-5: Groundwater Quantities

100 BC FS Groundwater Key Quantities				
DRAFT	Alternative Name	Alt2 - Less Action	Alt 3 - Moderate Action	Alt 4 - More Action
MNA		NA	NA	ECE-100BC111-00007
Average Sample Depth, ft		66	66	66
# of Events (First Year)		4	4	4
Samples/Event (First Year)		42	42	42
# of Yrs (Out Years)		103	68	48
Events per Yr (Out Years)		1	1	1
Samples/Event (Out Years)		42	42	42
New GW Monitoring Wells		11	11	11
Assumed well depth		200	200	200
Groundwater Extraction		NA	NA	NA
Number of Wells		NA	6	12
Flow rate per well, gpm		NA	75	75
Depth to Static Water Table, ft		NA	66	66
Depth to Top of Confining Layer, ft		NA	180	180
Depth to Base of Contamination, ft		NA	180	180
Assumed well depth		NA	200	200
Expected Safety Level		NA	D	D
Type of Submersible Pump		NA	4", 56-95 gpm, 101'<	4", 56-95 gpm, 101'<
Well Casing Diameter, in		NA	8	8
3" HDPE Transfer Piping, ft		NA	10951	14755
8" HDPE Transfer Piping, ft		NA	1376	1984
Influent Pumping Stations (New)		NA	1	2
Influent Pumping Station Flow, ea		NA	450	900
Influent collection tanks		NA	1	1
Tank Capacity Each, gal		NA	17500	35000
Groundwater Injection		NA	NA	NA
Number of Injection Wells		NA	6	12
Injection Rate per Well, gpm		NA	75	75
Depth to Top of Aquifer, ft		NA	53	53
Aquifer Thickness, ft		NA	125	125
Assumed well depth		NA	200	200
Expected Safety Level		NA	D	D
Well Casing Diameter, in		NA	8	8
Screen Length per well, ft		NA	105	105
3" HDPE Transfer Piping, ft		NA	24103	42602
8" HDPE Transfer Piping, ft		NA	98	526
10" HDPE Transfer Piping, ft		NA	NA	NA
Effluent Pumping Stations (New)		NA	1	2
Effluent Pumping Station Flow, ea		NA	450	900
Feed Tank(s)		NA	1	1
Tank Capacity Each, gal		NA	17500	35000
Well and Pump O&M Schedule		NA	NA	NA
Extraction Well Pump Replacement, yrs		NA	5	5
Extraction Well Rehab, yrs		NA	10	10
Extraction Well Replacement, yrs		NA	20	20
Injection Well Pump Replacement, yrs		NA	5	5
Injection Well Rehab, yrs		NA	2	2
Injection Well Replacement, yrs		NA	10	10
Monitoring Well Pump Replacement, yrs		5	5	5
Monitoring Well Rehab, yrs		NA	NA	NA
Monitoring Well Replacement, yrs		30	30	30
Treatment Systems		NA	NA	NA
Ion Exchange for Cr(VI), gpm (nominal)		NA	450	900
IX Bldg Square feet		NA	NA	NA
Ion Exchange for Sr-90, gpm (nominal)		NA	150	300
BioInfiltration area, sf		NA	NA	NA
BioInjection Flow, gpm		NA	0	NA
Wells w/ Sr-90 treated by IX		NA	2	4
P&T Monitoring Sample Points (EWs and effluent tank)		NA	7	13
Active P&T Monitoring - years		NA	64	16
During 1st yr P&T Monitoring - samples/yr per well		NA	4	4
After 1st year P&T Monitoring - samples/yr per well		NA	1	1
Post P&T Monitoring Verification - years		NA	5	Page 36 of 365
Post P&T Monitoring Verification - samples/yr per well		NA	2	2
Treatment systems annual online fraction		NA	0.85	0.85